

DOCKET NO.: DXYC-0039 / 03-0501D
Application No.: 10/561,768
Office Action Dated: October 4, 2010

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Yury Gogotsi

Confirmation No.: 1617

Application No.: 10/561,768

Group Art Unit: 1793

Filing Date: March 23, 2006

Examiner: Stuart L. Hendrickson

For: NANOPOROUS CARBIDE DERIVED CARBON WITH TUNABLE PORE SIZE

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

DECLARATION PURSUANT TO 37 CFR § 1.132

I, Dr. Yury Gogotsi, declare as follows:

- 1) I am currently Director of the A.J. Drexel Nanotechnology Institute, Trustee Chair and Distinguished University Professor of Materials Science and Engineering, Mechanical Engineering and Mechanics, and Chemistry at Drexel University. Previously, I have held positions as Associate Dean of the College of Engineering and Professor of Materials Science and Engineering at Drexel University and Associate Professor of Mechanical Engineering (with tenure) and Assistant Director, Research Resources Center at the University of Illinois at Chicago, Department of Mechanical and Industrial Engineering.
- 2) I have a D.Sc. in Materials Engineering from the National Academy of Sciences, Ukraine, a Ph.D. in Physical Chemistry from the Kiev Polytechnic Institute, Ukraine, and a Master's degree in Metallurgy, also from the Kiev Polytechnic Institute.
- 3) I am a Fellow in the American Association for Advancement of Science (AAAS), The Electrochemical Society, and the American Ceramic Society and have received numerous awards and accolades for my work in materials science including science of ceramics, carbon, nanomaterials, and nanofluidics. A full listing is provided in my curriculum vitae, provided as Attachment 1 to this declaration.

- 4) I have co-authored or edited 14 books, authored or co-authored more than 200 peer-reviewed journal papers, more than 100 papers in proceedings, filed 35 patent applications, and presented more than 100 invited lectures and seminars.
- 5) My current research interested include the chemistry of carbon nanomaterials, nanofluidics, and devices made therefrom.
- 6) I have studied and am familiar with U.S. Patent Application Serial No. 10/561,768 (the above-identified application, hereinafter “the ‘768 Application”), on which I am listed as an inventor, and the prosecution history associated with it. I believe myself to be well qualified to provide comment on the subject matter under consideration.
- 7) I understand the claims of the ‘768 Application to be directed to a method of preparing nanoporous carbon whose nanopore diameters can be adjusted in increments as low as 0.05 to 0.2 nm, by variations in processing temperature.
- 8) I have been asked to provide experimental data in support of amendments made in response to the office action dated October 4, 2010.
- 9) I am attaching to this declaration tabulated data resulting from experiments conducted at my direction and under my control. These experiments were conducted consistent with the teachings of the as-filed specification currently under consideration, and involved the halogenation of various carbide powders at increasing temperatures.
- 10) These experiments show that nanopore size changes of between 0.05 nm and about 2 nm can be achieved by changing the halogenation temperature, as described in the presently pending claims.

DOCKET NO.: DXYC-0039 / 03-0501D
Application No.: 10/561,768
Office Action Dated: October 4, 2010

PATENT

11) I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information or belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application, any patent issuing thereupon, or any patent to which this verified statement is directed.

Date: February 4, 2011

A handwritten signature in black ink, appearing to read "Yury Gogotsi", written over a horizontal line.

Dr. Yury Gogotsi

DOCKET NO.: DXYC-0039 / 03-0501D
Application No.: 10/561,768
Office Action Dated: October 4, 2010

PATENT

Attachment 1

Partial Curriculum Vitae for Yury Gogotsi

Drexel University, Department of Materials Science and Engineering
(215) 895 6446, gogotsi@drexel.edu, <http://nano.materials.drexel.edu>

Education

D.Sc. Materials Engineering, National Academy of Sciences, Ukraine, 1995
Ph.D. Physical Chemistry, Kiev Polytechnic Institute, Ukraine, 1986
M.S. Metallurgy, Kiev Polytechnic Institute, Ukraine, 1984

Professional Appointments

Drexel University, Department of Materials Science and Engineering

| | |
|-------------------|---|
| 09/2008 – present | Trustee Chair Professor of Materials Science |
| 02/2003 – present | Director, A.J. Drexel Nanotechnology Institute |
| 09/2002 – present | Assistant Professor, Professor of Chemistry |
| 12/2002 – 9/2007 | Associate Dean of the College of Engineering |
| 11/2001 – present | Professor of Mechanical Engineering and Mechanics |
| 08/2000 – 08/2008 | Professor of Materials Science and Engineering, University of Illinois at Chicago (UIC), Department of Mechanical Engineering |
| 9/2001 – 8/2003 | Adjunct Professor of Mechanical Engineering |
| 6/1999 – 9/2000 | Associate Professor of Mechanical Engineering (with tenure) |
| 9/1999 – 8/2000 | Assistant Director, UIC Research Resources Center |
| 10/1996 – 5/1999 | Assistant Professor of Mechanical Engineering |

Current Research Interests

Chemistry of carbon nanomaterials, nanofluidics, electrochemical capacitors, Raman spectroscopy

Publications

2 books co-authored, 12 books edited, 15 book chapters, more than 180 journal papers, 90 papers in proceedings, 35 patents filed, more than 100 invited lectures and seminars.

Five Recent Related Publications:

1. J. Chmiola, C. Largeot, P.-L. Taberna, P. Simon, Y. Gogotsi, Monolithic Carbide-Derived Carbon Films for a New Generation of Micro-Supercapacitors, ***Science***, 238, 480-48 (2010)
2. J. Chmiola, C. Largeot, P.-L. Taberna, P. Simon, Y. Gogotsi, Desolvation of ions in subnanometer pores, its effect on capacitance and double-layer theory, ***Angewandte Chemie Int. Ed.***, 47 (18), 3392-3395 (2008)
3. C. Largeot, C. Portet, J. Chmiola, P.L. Taberna, Y. Gogotsi, P. Simon, Relation between the Ion Size and Pore Size for an Electric Double-Layer Capacitor, ***J. Am. Chem. Soc.*** 130 (9), 2730-2731 (2008)
4. P. Simon, Y. Gogotsi, Materials for Electrochemical Capacitors, ***Nature Materials***, 7, 845-54 (2008)
5. J. Chmiola, G. Yushin, Y. Gogotsi, C. Portet, P. Simon, and P. L. Taberna, Anomalous Increase in Carbon Capacitance at Pore Sizes Less Than 1 Nanometer, ***Science***, 313, 1760-1763 (2006)

Other Important Related Publications:

6. T. Kyotani, J. Chmiola, Y. Gogotsi, Carbide Derived Carbon and Templated Carbons, Chapter 3 in ***Carbon Materials for Electrochemical Energy Storage Systems***, edited by F. Beguin and E. Frackowiak, CRC Press/Taylor and Francis, pp. 77-113 (2009).
7. J. Chmiola, Y. Gogotsi, Supercapacitors as Advanced Energy Storage Devices, ***Nanotechnology Law and Business***, 4(1), 577-584 (2007)

8. Y. Gogotsi, A. Nikitin, H. Ye, W. Zhou, J.E. Fischer, B. Yi, H. C. Foley, M. W. Barsoum, Nanoporous carbide-derived carbon with tuneable pore size, *Nature Materials*, 2 (9) 591–594 (2003)
9. Y. Gogotsi, S. Welz, D.A. Ersoy, M.J. McNallan, Conversion of Silicon Carbide to Crystalline Diamond-Structured Carbon at Ambient Pressure, *Nature*, 411, 283-287 (2001)
10. Y. Gogotsi, J. Libera, N. Kalashnikov, M. Yoshimura, Graphite Polyhedral Crystals, *Science*, 290, 317-320 (2000)

Professional Awards and Recognitions

- 2009 Fellow, American Association for Advancement of Science (AAAS)
- 2008 Fellow, The Electrochemical Society
- 2006 Innovator Award, NANO 50TM, NASA Tech Briefs
- 2005 Fellow, American Ceramic Society
- 2005 Drexel University College of Engineering Outstanding Research Award
- 2004 Academician, World Academy of Ceramics
- 2003 R&D 100 Award from R&D Magazine (awarded again in 2009)
- 2003 R.B. Snow Award from the American Ceramic Society (re-awarded in 2005 and 2007)
- 2002 S. Somiya Award from the International Union of Materials Research Societies
- 2002 G.C. Kuczynski Prize from the International Institute for the Science of Sintering
- 2002 Elected Full Member, International Institute for the Science of Sintering
- 2002 Drexel University Research Achievement Award (awarded again in 2009)
- 2001 Winner of the Collegiate Inventors Competition, the National Inventors Hall of Fame
- 1999 University of Illinois-Chicago College of Engineering Faculty Research Award
- 1993 I.N. Frantsevich Prize from the Ukrainian Academy of Sciences
- 1993 – 1995 NATO/Norwegian Research Council Fellowship, University of Oslo, Norway
- 1992 – 1993 Japan Society for the Promotion of Science (JSPS) Fellowship, Tokyo Inst. Techn., Japan
- 1990 – 1992 Alexander von Humboldt Fellowship, University of Karlsruhe, Germany

DOCKET NO.: DXYC-0039 / 03-0501D

PATENT

Application No.: 10/561,768

Office Action Dated: October 4, 2010

Selected Synergistic Activities

Directed: 2 NSF IGERT, 2 NSF RET as PI and 2 NSF RET programs as Co-PI

Panel Co-Chair: *DOE Workshop on Basic Research Needs for Electrical Energy Storage*, 2007

Director:

NATO Advanced Research Workshop on Nanostructured Materials and Coatings for Biomedical and Sensor Applications, Kiev, Ukraine (2002); *NATO Advanced Study Institute on Materials Science of Carbides, Nitrides and Borides*, St. Petersburg, Russia (1998)

Coordinator: Mentorship Program with Illinois Academy of Math and Sciences, 1999/2000

Co-Director: *International Workshop on Hysteresis, Metastability and Aftereffect*, Chicago, IL (2000)

Guest Professor: University of Limoges, France (May-June 1994, June 1999, July 2005); Paul Sabatier University, Toulouse, France (Oct.-Dec. 2007)

Editorship:

Nanomaterials Handbook (CRC Press, Boca Raton) 2006, 800 pp.; *Carbon Nanomaterials* (CRC Press, Boca Raton) 2006, 326 pp; *CARBON* (Elsevier)

Associate Editor or a Member of the Editorial Board:

AZojomo - Journal of Materials Online, since 2005; *Advances in Applied Ceramics*, since 2005; *British Ceramic Transactions*, 2004, *International Journal of Applied Ceramic Technology*, 2003-2007; *Reviews in Advanced Materials Science*, since 2000; *Materials Physics and Mechanics*, since 2000; *Advances in Technology of Materials and Materials Processing Journal (ATM)*, since 1998; *J. Materials Processing and Manufacturing Science* (1997-2002); *Advanced Ceramics and Glass* (1992-1993)

Acted as reviewer:

Science, *Nature*, *Nature Materials*, *Nature Nanotechnology*, *Nano Letters*, *Advanced Materials* and other journals; The Petroleum Research Fund, Humboldt Foundation,

DOCKET NO.: DXYC-0039 / 03-0501D

PATENT

Application No.: 10/561,768

Office Action Dated: October 4, 2010

CNRS (France), DFG (Germany); National Research Council (NRC), Department of State, DOE, NSF and other agencies

Attachment 2. Results of experiments where various carbides were halogenated at incremental temperatures.

| Carbide Type | Chlorination temp., °C | Annealing temp., °C | Annealing type | BET SSA, m ² /g | Pore size, nm |
|---------------------------|------------------------|---------------------|-----------------|----------------------------|---------------|
| nanoTiC-CDC | 200 | 200 | H ₂ | 324 | 0.56 |
| | 200 | 600 | H ₂ | 434 | 0.58 |
| | 400 | 400 | H ₂ | 740 | 0.62 |
| | 400 | 600 | H ₂ | 1002 | 0.69 |
| | 600 | 600 | H ₂ | 952 | 0.85 |
| | 800 | 600 | H ₂ | 1855 | 0.86 |
| | 1000 | 600 | H ₂ | 1920 | 0.96 |
| | 1200 | 600 | H ₂ | 619 | 1.71 |
| microTiC-CDC | 200 | 200 | H ₂ | 497 | 0.52 |
| | 400 | 600 | H ₂ | 910 | 0.53 |
| | 600 | 600 | H ₂ | 1383 | 0.60 |
| | 700 | 600 | H ₂ | 1832 | 0.66 |
| | 800 | 600 | H ₂ | 1772 | 0.80 |
| | 1000 | 600 | H ₂ | 1669 | 0.78 |
| | 1200 | 600 | H ₂ | 1540 | 0.94 |
| microTiC-CDC (activated) | 600 | 1500 | vacuum | 1776 | 0.85 |
| | 800 | 600 | NH ₃ | 2094 | 0.76 |
| | 400 | 600 | KOH | 2911 | 0.72 |
| | 500 | 600 | KOH | 3101 | 0.96 |
| | 800 | 600 | KOH | 2565 | 0.79 |
| micro-SiC | 800 | 600 | H ₂ | 1274 | 0.85 |
| | 900 | 600 | H ₂ | 1128 | 0.87 |
| | 1200 | 600 | H ₂ | 1016 | 0.97 |
| microZrC-CDC | 400 | 600 | H ₂ | 494 | 0.74 |
| | 600 | 600 | H ₂ | 859 | 0.80 |
| | 800 | 600 | H ₂ | 1342 | 0.83 |
| | 1000 | 600 | H ₂ | 1499 | 1.21 |
| | 1200 | 600 | H ₂ | 1857 | 1.41 |
| microB ₄ C-CDC | 800 | 600 | H ₂ | 1824 | 0.97 |
| | 1000 | 600 | H ₂ | 1701 | 0.93 |
| | 1200 | 600 | H ₂ | 1088 | 1.43 |

DOCKET NO.: DXYC-0039 / 03-0501D

PATENT

Application No.: 10/561,768

Office Action Dated: October 4, 2010

| | | | | | |
|--------------------------------|-----|-----|----|------|------|
| microMo ₂ C- CDC | 400 | 600 | H2 | 1131 | 0.77 |
| | 500 | 600 | H2 | 1546 | 0.99 |
| | 600 | 600 | H2 | 1963 | 1.45 |
| | 700 | 600 | H2 | 1789 | 1.50 |
| | 800 | 600 | H2 | 1589 | 1.67 |